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PACKAGE BUILDING WITH PRECIFX

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ABSTRACT

Yarn from ring frame bobbins is wound onto bigger packages on Automatic winding machines. Grooved drum winding system has been used on these machines over decades that have several limitations and rewinding of these packages may become essential to cater needs of some end use applications. Oerlikon-Schlafhorst (now Saurer-Schlafhorst) introduced PreciFX winding system in year 2007 that provides drum less traverse and opens up entirely new possibilities in package building on Automatic winding machines which is highlighted in this article.

KEYWORDS: Automatic Winding Machine, Drum Pitch, Symmetry Ratio

INTRODUCTION

Since several decades winding using grooved drums is well established and is a proven technique, even on the Automatic winding machines. Although the winding system with grooved drums is simple and cost effective, it still has some limitations. Use of grooved drum gives random winding leading to frequent occurrence of undesirable pattern zones. Traverse length cannot be flexibly altered during package build up, which forbids package formats like bi-conical packages from being achieved. To change the extent of traverse acceleration and/or stroke length, it becomes necessary to replace grooved drum by opting for other modes of winding. Thus the aforesaid limitations may be overcome by including an additional process of rewinding that offers options of precision/ step precision winding, traverse length variation for effective hard edge prevention/avoidance of package bulging at side flanks/ bi-conical package, variation of traverse ratio/coil angle during package build up etc. Oerlikon-Schlafhorst (now Saurer-Schlafhorst) introduced a revolutionary PreciFX winding system in year 2007 where in package is surface driven by a plain drum and traverse is given by a traverse lever. Winding drum and traverse lever are driven by separate motors. This system shows new avenues in package building this paper discusses salient features of PreciFX plus winding system being employed in the industry.

Understanding PreciFX

Figure 1 shows the working principle of PreciFX system. Package ‘A’ is rotated by surface contact with a groove less drum (drive roller) ‘B’ which is driven by a servomotor ‘E’. Yarn ‘G’ passes through traversing guide ‘D’on a traverse lever ‘C’ that gets rocking motion from a servomotor ‘F’.

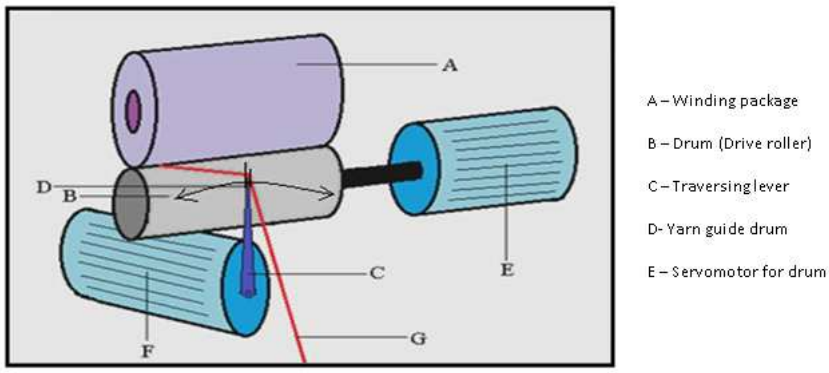

Figure 1: The Working Principle of Precifx System

Winding this is a flexible winding system that permits any desired ratio between drum rotational speed and traverse frequency of traverse lever enabling the system to operate on any mode of winding like random, precision or step-precision. The system can vary speed of traversing lever at every point during its movement from one end to the other thereby permitting selection of desired traverse acceleration as well as traverse stroke during package build up, allowing edge displacement, building bi-conical package etc. Figure 2 shows the photograph of such system on Autoconer X5.

Figure 2: Photograph of Precifx System

Winding Parameters Related To Precifx

In random winding mode, winding ratio decreases with increase in package diameter. With a cylindrical package, coil angle remains constant. Parameters to be input for random winding are discussed below.

- **Mean Pitch**

Industry persons dealing with automatic winding machines are more conversant with terms related to grooved drums as it is one of the most popular systems. In a grooved drum, pitch refers to number of rotations made by the drum to complete a single traverse. Drum pitch in a way influences coil angle. Higher the pitch, lower will be the coil angle and vice versa. In PreciFX, the user has to input mean pitch whose setting range is from 1.0 to 4.0 and can be selected in incremental steps of 0.1. Thus through mean pitch, user inputs mean coil angle. Coil angle influences package variables like density, hard edge formation, unwinding characteristics and tendency to slough off. Lower coil angle gives greater package density, harder edges, increased tension peaks during unwinding and decreased chances of slough off. It must be noted that grooved drums do not provide this flexibility in terms of varying the pitch or the coil angle.

- **Symmetry Ratio**

The terms “symmetric drum” and “asymmetric drum” are well known. A symmetric drum is used for a cylindrical winding package in which the groove angle and thereby the traverse speed remains constant from one end to the other. An asymmetric drum is used for conical packages in which groove angle varies from one end to the other to give slower traverse towards base and faster towards nose. This difference in traverse speed lays more yarn towards base than at nose since surface area available to accommodate yarn is greater towards base than nose. The extent of difference in traverse speed is the function of cone taper. Higher the cone taper, greater is the difference in traverse speed. This traverse speed difference is termed as “traverse acceleration.” Figures 3 (a) and (b) show symmetric and asymmetric drum, where difference in the pitch as well as helix angle can be observed.

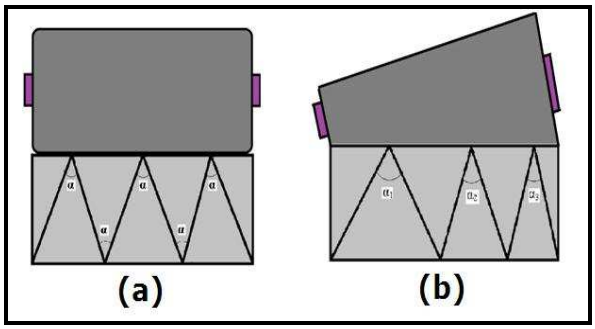

Figure 3: (a) Symmetric Drum and (b) Asymmetric Drums

The parameter “symmetry ratio” in PreciFX determines the traverse acceleration. For cylindrical packages, traversing lever speed would remain the same from one end to the other in order to maintain same coil angle. For conical packages, traversing lever would move slower towards base and faster towards nose. Symmetry ratio indicates ratio of traversing lever speed towards left and right extremes. Symmetry ratio of 1 indicates same speed of traversing lever towards left and right suitable for cylindrical packages. The symmetry ratio can be selected depending upon whether the machine is ‘p’ or ‘q’ type.

For ‘p’ wind (where cone nose lies towards left) it ranges from 1 to 2 and can be selected in incremental steps of 0.1. Symmetry ratio greater than one indicate accelerated traverse for ‘p’ wind. Here greater is the selected symmetry ratio, greater is traverse acceleration.

For ‘q’ wind (where cone base lies towards left), it ranges from 0.5 to 1 (this range is reciprocal of range for ‘p’ wind). Symmetry ratio smaller than one indicate accelerated traverse for ‘q’ wind. Here smaller is the selected symmetry ratio, greater is traverse acceleration.

Recommended values for ‘p’ wind are inbuilt in ‘Informator’ of the machine that gives idea about the selection of symmetry ratio with reference to the cone taper. Table 1 shows the recommended values of symmetry ratio for different cone tapers of winding package.

Table 1: Shows Values Recommended by the Manufacturer

No.	Conicity	Symmetry Ratio	
		for ‘P’ Wind	for ‘P’ Wind
1.	3˚30’	1.10-1.15	0.88-0.91
2.	4˚20’	1.20-1.24	0.81-0.83
3.	5˚57’	1.30-1.38	0.72-0.77

With an increase in symmetry ratio for 'p' wind, difference in coil angle at cone base and nose widens resulting in increased package hardness towards cone base and decreased hardness towards cone nose. Thus, PreciFX winding system permits winding of different cone tapers on a given spindle through the input of symmetry ratio. Of course it becomes necessary to change package adapter when supply package of different conicity is mounted.

- **Parameters for Ribbon Breaking**

Pattern/ribbon formation is the greatest drawback of random winding/grooved drum system. In grooved drum winding "skid principle" is often used for ribbon breaking in which drum speed is periodically varied over a narrow range continuously that is expected to bring about slippage between drum and package to breaks ribbons. Slippage between drum and package is the function of frictional force between drum and package. Frictional force between drum and package depends upon surface characteristics of drum and yarn wound on the package as well as cradle pressure. With higher frictional force, adequate slippage may not take place between drum and package and ribbons may not be split adequately. Autoconer provides the feature "PropackFX" in which cradle pressure is decreased during major ribbon zones that decreases frictional force to ensure slippage between drum and the package in these regions.

In PreciFX winding system, package drive and traverse are isolated due to which ribbons can be tackled more effectively and a virtually ribbon free package can be built even in Random winding mode. Following two parameters are to be input for ribbon breaking.

- **Ribbon Breaking**

In grooved drum winding ribbon breaking is achieved by bringing about a situation that disturbs rotational ratio between drum and package continuously. Whereas with PreciFX winding, this effectively achieved by varying the traverse lever frequency throughout the build-up thus disrupting the winding ratio. Figure 4 shows screen shot of Autoconer X5 Informator for "ribbon breaker".

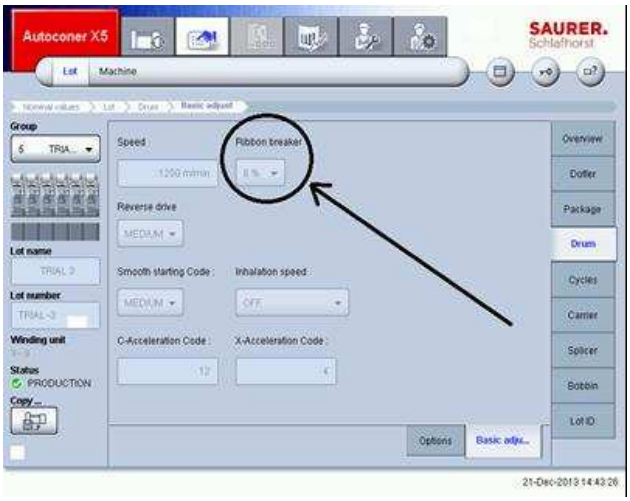

Figure 4: "Ribbon Breaker"

For this, on the "Informator" ribbon breaker % has to be set which ranges from 3 to 12 adjustable in incremental steps of 3. Traverse lever frequency is varied by the % set. Higher is the % set, greater is the disturbance in frequency of traverse lever and vice-versa.

- **Zonal Ribbon Breaking (ZRB)**

Though ribbon breaker option is provided that varies the traverse lever frequency to break the pattern formation. However, ribbons may not be effectively broken at critical ribbon zones through this function. To take care of these critical ribbon zones (for example, when winding ratio becomes a whole number), "zonal ribbon breaking" function is provided. Figure 5 shows screen shot of Autoconer X5 Informator for PreciFX for ZRB.

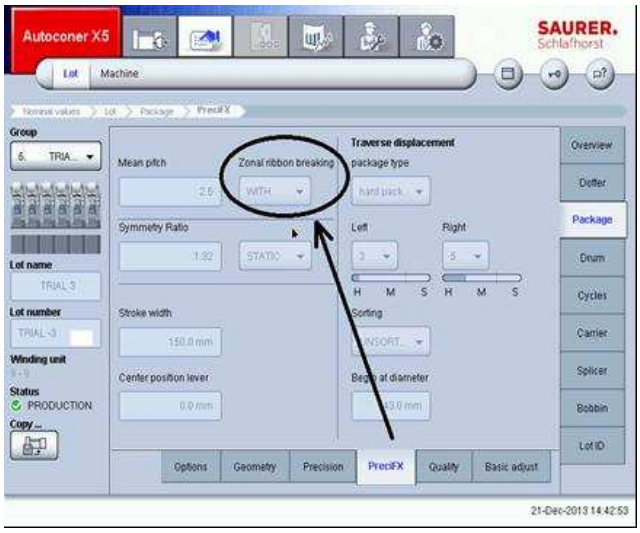

Figure 5: "Zonal Ribbon Breaking (ZRB)"

This function takes care of the critical pattern zones and ensures ribbon free winding. If a package is random wound; winding ratio keeps on reducing with increase in package diameter. During its build-up, it passes through several winding ratios where pattern formation takes place. Suppose, as the package diameter is building up it reaches diameter "d_1", where winding ratio is 5. A better idea can be had if the inset shown in Figure 6 is observed.

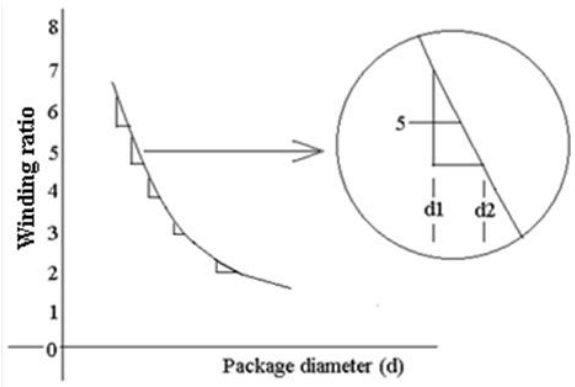

Figure 6: Zonal Ribbon Breaking In Random Winding (ZRB)

Then winding ratio is suddenly decreased to a value that does not lead to pattern formation and is continued till diameter "d_2" is reached. But reduction in winding ratio also leads to instantaneous increase in coil angle while beyond this diameter random winding is continued again. Thus, zonal ribbon breaker brings about an instantaneous switch over to a lower non-pattern forming wind ratio before reaching patterning stage and in this manner winding is carried out without major patterns in the package. Therefore, PreciFX winding system gives "Pattern-free random winding".

- **Stroke Width Variation**

With grooved drum winding, traverse stroke remains the same, due to which package formats like a bi-conical package cannot be formed. Traversing system on PreciFX winding is flexible and can permit programmable variation in traverse strike width due to which various package formats like bi-conical packages, packages with reduced stroke length and packages with rounded edges become possible. Problem of package bulging at side faces can also be avoided through stroke variation. Edge displacement function allows scattering of reversal points over different width at nose and base to obtain soft side flanks. Coil angle can be varied during package build up due to which features like protection layer become possible.

- **Producing Pckages Different Widths**

Traversing system on PreciFX winding permits production of packages with any required width; for example it becmoes possible to produce 3” or 4” packages instead of 6” as required packages fed for doubling on TFO twisting using appropriate adapters. Figure 7 shows 3” packages for TFO twisting.

Figure 7: Photograph of Packages for Twisting With 3” Traverse

If same is to be achieved on a grooved drum winder, it becomes esential to replace drum along with package adapter. It also becomes possible to wind package with decreased stroke on a longer tube at any desired position. For example, instead of 6” stroke, packages with 4” stroke can be produced. This 4” stroke may be poistioned at centre, towards right or left of the tube. Figure 8 shows winding with shorter stroke on left side.

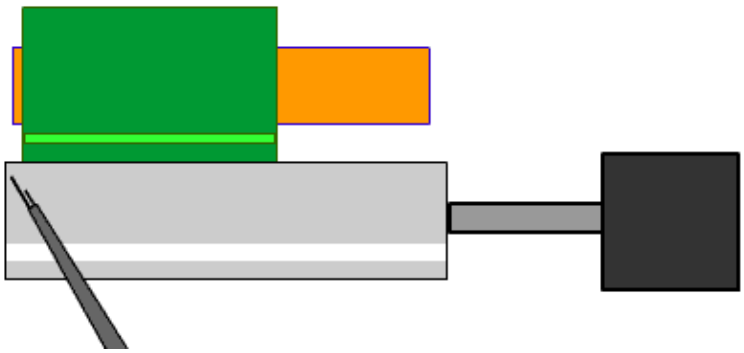

Figure 8: Winding With Shorter Stroke on Left Side

It is well known that packages with shorter traverse lengths built to larger diameters (known as “Sun cheesees”) are found very advantagesous as weft supply packages on shuttleless looms.

- **Production of Dye Packages with Rounded Edges**

Flow of dye liquor is minimal as compared to other regions and therefore edges become “dead zones” from dyeing point of view as shown in Figure 9 (a) where dye pick up tends to be less

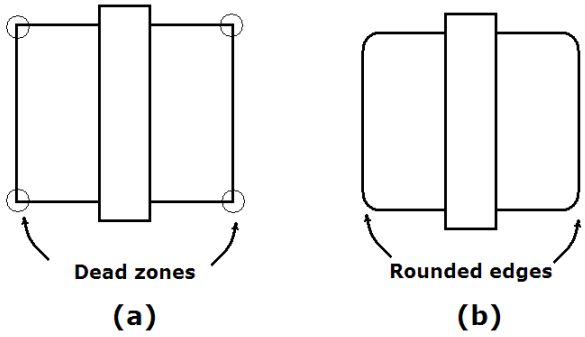

Figure 9: Cylindrical Package (a) with Dead Zones (b) with Rounded Edges

leading to uneven dyeing. These dead zones can be eliminated if a dye package is with rounded edges Figure 9 (b). A grooved drum winding system cannot produce packages with rounded edges as traverse length can not be varied. PreciFX winding system can produce dye packages with rounded edges of desired radius for which stroke length is progressively reduced towards the end. Figure 10 shows a dye package with rounded edges produced onPreciFX winding systems.

Figure 10: Photograph of Cylindrical Package with Rounded Edges

- **Protection Layer for Dye Packages**

PreciFX system permits winding a package with different coil angles in different segments of package. This enables laying of a protection layer at the beginning of every new bare package in which winding begins at a low speed for defined yarn length at redced coil angle. This protection layer act as a filter and prevents entry of any undissolved dye particle in the yarn on the package. Due to this layer it is not necessary to mount any web covering on a bare package.

- **Edge Displacement**

Side flanks of cross wound packages become hard as a sharp yarn reversal is not practically possible at extremes. Packages with soft side flanks can be produced by dispersing reversal points over a defined width. In grooved drum winding drum or cradle is given lateral displacement. In PreciFX winding, the same can be achieved through edge

displacement function that continually vary the edge position of traverse lever over a defined width. The edge displacement is kept the same on both sides for a cylindrical package. For conical packages, it is lesser at nose side and greater at base side.

Production of Bi-Conical Packages

PreciFX winding also permits production of biconical packages through progressive stroke reduction. Stroke width can be reduced independently on left and right side. Figure 11 shows photograph of a bi-conical package .

Figure 11: Biconical Package Produced with Precifx

CONCLUSIONS

PreciFX winding system opens up entirely new possibilities in package building on an automatic winding machine. The user can exploit capabilities of this system to produce a package on an automatic winding machine best suited for requirements of its end use. This system has wide scope for its further development.

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